

REMARKS

Claims 1-10 were examined and reported in the Office Action. Claims 1-10 are rejected. Claims 1-3 and 8 are amended. Claims 1-10 remain.

On page 12, line 24 of the specification, typographical error "0°C" is corrected to -100°C-. "The heater surrounding the entire chamber is maintained to have a temperature of 100°C" is apparent from the descriptions on page 7, lines 5-10 and page 12, line 26 - page 13, line 1.

Claims 1-3 and 8 are amended to particularly point out and distinctly claim the subject matter without the addition of new matter. Since the additional limitation is described in page 12, line 24 - page 13, line 1 of the original specification, it is apparent that the amended claims do not include new matter.

Applicant requests reconsideration of the application in view of the following remarks.

I. 35 USC 103(a)

A. It is asserted in the Office Action that claims 8-10 are rejected under 35 U.S.C 103(a) as being unpatentable over U.S. Patent No: 5,294,568 issued to McNeilly et al. ("McNeilly") in view of U.S. Patent No. 5,772,902 issued to Reed et al. ("Reed"). Applicant respectfully disagrees.

According to MPEP 2142 "[t]o establish a prima facie case of obviousness, three basic criteria must be met. First, there must be some suggestion or motivation, either in the references themselves or in the knowledge generally available to one of ordinary skill in the art, to modify the reference or to combine reference teachings. Second, there must be a reasonable expectation of success. Finally, the

prior art reference (or references when combined) must teach or suggest all the claim limitations. The teaching or suggestion to make the claimed combination and the reasonable expectation of success must both be found in the prior art, and not based on applicant's disclosure." (*In re Vaeck*, 947 F.2d 488, 20 USPQ2d 1438 (Fed. Cir. 1991)). Further, according to MPEP 2143.03, "[t]o establish prima facie obviousness of a claimed invention, all the claim limitations must be taught or suggested by the prior art. (*In re Royka*, 490 F.2d 981, 180 USPQ 580 (CCPA 1974). "All words in a claim must be considered in judging the patentability of that claim against the prior art." (*In re Wilson*, 424 F.2d 1382, 1385, 165 USPQ 494, 496 (CCPA 1970), emphasis added).

Applicant's amended claim 8 contains the limitations of "...removing the silicon oxide of a sacrificial layer by performing a vapor etching using anhydrous HG and alcohol by controlling a temperature and a pressure inside of an etching chamber to be within the region of a vapor of a phase equilibrium diagram of water, wherein the temperature of the etching chamber is maintained to be higher than that of the substrate so as to discharge the gas without condensing the water and to control physical adsorption amounts of reactant molecules adsorbed on the sacrificial layer."

Applicant's claimed invention discloses a method for releasing a microstructure when fabricating a MEMS device having a long microstructure, e.g., 1200 μ m cantilever (see Applicant's Figure 6). The vapor etching is controlled by formation of HF_2^- that results from the ionization reaction between anhydrous HF and alcoholic vapor adsorbed physically on the silicon oxide surface (See the attached Figure 1). Applicant's attached Figure 1 illustrates that temperature and pressure are controlled to be within the vapor region of a phase equilibrium diagram of water. In other words, a temperature inside of an etching chamber is maintained to be higher than that of a substrate so as to discharge the water

generated during the vapor etching without condensation, during a slow gas-solid reaction. Accordingly, because of the vapor etching without condensation, the etching process in the gas-phase regime (See Applicant's Attached Figure 2) can be performed. (see also, Applicant's Figure 7).

McNeilly discloses a method for selective etching of native oxide on a substrate. In McNeilly, since the water vapor is condensed and vapor etching of the native oxide is not performed, treating conditions are maintained to prevent water vapor from condensing on the substrate until sufficient native oxide is etched. Therefore, substantially all the native oxide is etched before appreciable other oxide (e.g., thermal oxide, CVD) are etched. In other words, the temperature and pressure in the reactor are controlled to delay condensation of wafer vapor until the sufficient native oxide is etched, before appreciable other oxide are etched. (see McNeilly, abstract; column 7, lines 14-46)

Reed discloses a wet etching method. In the wet etching method disclosed by Reed, a cleansing solution such as a de-ionized (DI) water, methanol, isopropyl alcohol or 2-Propanol is used to rinse and remove the remaining HF solution. By surface tension due to the residue, i.e., the cleansing solution in a gap of a micron unit between the microstructure and the substrate, a capillary force is generated. (See Reed, column 7 line 18 – column 8, line 14). Referring to Reed's Figure 11 and column 15, lines 25-34, the dimensions of the resulting micromachined doubly clamped beams were 170 μm long \times 30 μm wide \times 1.35 μm thick. As in the above mentioned problem, Reed's method can not be used for fabricating a MEMS device having a long microstructure, e.g., 1200 μm cantilever (see Applicant's Figure 6).

McNeilly fails to teach, disclose or suggest the absence of condensation of water vapor on the substrate during a slow gas-solid reaction. In other words, according to McNeilly, condensation is prevented for only a short time. The temperature and pressure in the reactor are controlled to delay condensation of the

wafer vapor until the sufficient native oxide is etched before appreciable other oxide are etched.

Reed fails to teach prevention of stiction generated by a surface tension due to the residue during or after etching. Accordingly, the method disclosed by Reed can not be used for releasing a microstructure for fabricating a MEMS device having a long microstructure.

Therefore, even if McNeilly is combined with Reed, the resulting invention would still not arrive with Applicant's claimed invention because neither McNeilly, Reed, nor the combination of the two, teach, disclose or suggest all the limitations of Applicant's amended claim 8. Since McNeilly, Reed, or the combination of the two, do not disclose, teach or suggest all the limitations contained in Applicant's amended claim 8, as listed above, there would not be any motivation to arrive at Applicant's claimed invention. Thus, Applicant's amended claim 8 is not obvious over McNeilly in view of Reed since a *prima facie* case of obviousness has not been met under MPEP 2142. Additionally, the claims that directly or indirectly depend from Applicant's amended claim 8, namely claims 9-10, are also not obvious over McNeilly in view of Reed for the above same reason.

Accordingly, withdrawal of the 35 U.S.C. § 103(a) rejection for claims 8-10, is respectfully requested.

B. It is asserted in the Office Action that claims 1-3, and 5-7 are rejected under 35 U.S.C 103(a) as being unpatentable over McNeilly in view of U.S. Patent No. 6,126,734 issued to Bergman et al. ("Bergman") and further in view of Reed. Applicant respectfully disagrees.

Applicant's amended claim 1 contains the limitations of "[a] method for releasing a microstructure for fabricating a device of a micro electro mechanical

system (MEMS), comprising: supplying bubbled alcohol vapor as a catalyst with anhydrous HF; maintaining a temperature of the supplying device and a moving path of the anhydrous HF and the alcohol to be higher than a boiling point of the alcohol; performing a vapor etching by controlling a temperature and a pressure to be within the vapor region of a phase equilibrium diagram of water, thereby removing silicon oxide of a sacrificial layer on a lower portion of the microstructure, wherein the vapor etching via a slow gas-solid reaction is controlled by formation of HF_2^- resulted from ionization reaction between anhydrous HF and alcoholic vapor adsorbed physically on the silicon oxide surface, while a temperature inside of an etching chamber is maintained to be higher than that of a substrate so as to discharge the water generated during the vapor etching without condensation."

Bergman discloses a method using vapor phase processing streams made from a liquid phase source and feed gas. Bergman, however, does not teach, disclose or suggest the absence of condensation of water vapor on the substrate during a slow gas-solid reaction nor prevention of stiction generated by a surface tension due to the residue during or after etching.

As discussed above, McNeilly in view of Reed are discussed above in section I(A) in regard to Applicant's amended claim 8. Regarding claim 1, Applicant asserts the following: McNeilly fails to teach, disclose or suggest the absence of condensation of water vapor on the substrate during a slow gas-solid reaction. In other words, according to McNeilly, condensation is prevented for only a short time. The temperature and pressure in the reactor are controlled to delay condensation of the wafer vapor until the sufficient native oxide is etched before appreciable other oxide are etched. Reed fails to teach prevention of stiction generated by a surface tension due to the residue during or after etching. Accordingly, the method disclosed by Reed can not be used for releasing a microstructure for fabricating a MEMS device having a long microstructure.

Therefore, even if McNeilly is combined with Bergman and Reed, the resulting invention would still not arrive with Applicant's claimed invention because neither McNeilly, Bergman, Reed, nor the combination of the three, teach, disclose or suggest all the limitations of Applicant's amended claim 1. Since McNeilly, Bergman, Reed, or the combination of the three, do not disclose, teach or suggest all the limitations contained in Applicant's amended claim 1, as listed above, there would not be any motivation to arrive at Applicant's claimed invention. Thus, Applicant's amended claim 1 is not obvious over McNeilly in view of Bergman and further in view of Reed since a *prima facie* case of obviousness has not been met under MPEP 2142. Additionally, the claims that directly or indirectly depend from Applicant's amended claim 1, namely claims 2-3 and 5-7, are also not obvious over McNeilly in view of Bergman and in further view of Reed for the above same reason.

Accordingly, withdrawal of the 35 U.S.C. § 103(a) rejection for claims 1-3 and 5-7, is respectfully requested.

C. It is asserted in the Office Action that claim 4 is rejected under 35 U.S.C. 103(a) as being unpatentable over McNeilly in view of Bergman and further in view of Reed and U.S. Patent No. 6,126,734 issued to Thakur et al. ("Thakur"). Applicant respectfully disagrees.

Applicant's claim 4 directly depends on Applicant's amended claim 1, which contains the limitations of "[a] method for releasing a microstructure for fabricating a device of a micro electro mechanical system (MEMS), comprising: supplying bubbled alcohol vapor as a catalyst with anhydrous HF; maintaining a temperature of the supplying device and a moving path of the anhydrous HF and the alcohol to be higher than a boiling point of the alcohol; performing a vapor etching by controlling a temperature and a pressure to be within the vapor region of a phase

equilibrium diagram of water, thereby removing silicon oxide of a sacrificial layer on a lower portion of the microstructure, wherein the vapor etching via a slow gas-solid reaction is controlled by formation of HF_2^- resulted from ionization reaction between anhydrous HF and alcoholic vapor adsorbed physically on the silicon oxide surface, while a temperature inside of an etching chamber is maintained to be higher than that of a substrate so as to discharge the water generated during the vapor etching without condensation."

Thakur discloses a process for etching oxides having differing densities that produces uniform etches by providing an oxide layer on a surface of a substrate, exposing the oxide layer to a liquid including a halide-containing species, and exposing the oxide layer to a gas phase including a halide-containing species. Thakur, however, does not teach, disclose or suggest the absence of condensation of water vapor on the substrate during a slow gas-solid reaction nor prevention of stiction generated by a surface tension due to the residue during or after etching.

McNeilly in view of Bergman and further in view of Reed are discussed above in section I(B) in regard to Applicant's amended claim 1. Applicant's amended claim 1 contains the limitations of "wherein the vapor etching via a slow gas-solid reaction is controlled by formation of HF_2^- resulted from ionization reaction between anhydrous HF and alcoholic vapor adsorbed physically on the silicon oxide surface, while a temperature inside of an etching chamber is maintained to be higher than that of a substrate so as to discharge the water generated during the vapor etching without condensation."

McNeilly fails to teach, disclose or suggest the absence of condensation of water vapor on the substrate during a slow gas-solid reaction. In other words, according to McNeilly, condensation is prevented for only a short time. The

temperature and pressure in the reactor are controlled to delay condensation of the wafer vapor until the sufficient native oxide is etched before appreciable other oxide are etched.

Reed fails to teach prevention of stiction generated by a surface tension due to the residue during or after etching. Accordingly, the method disclosed by Reed can not be used for releasing a microstructure for fabricating a MEMS device having a long microstructure.

Bergman fails to teach, disclose or suggest the absence of condensation of water vapor on the substrate during a slow gas-solid reaction nor prevention of stiction generated by a surface tension due to the residue during or after etching.

Therefore, even if McNeilly is combined with Bergman, Reed and Thakur, the resulting invention would still not arrive with Applicant's claimed invention because neither McNeilly, Bergman, Thakur, Reed, nor the combination of the four, teach, disclose or suggest all the limitations of Applicant's amended claim 1. Since McNeilly, Bergman, Reed and Thakur or the combination of the three, do not disclose, teach or suggest all the limitations contained in Applicant's amended claim 1, as listed above, there would not be any motivation to arrive at Applicant's claimed invention. Thus, Applicant's amended claim 1 is not obvious over McNeilly in view of Bergman and further in view of Reed and Thakur since a *prima facie* case of obviousness has not been met under MPEP 2142. Additionally, the claim that directly depends from Applicant's amended claim 1, namely claim 4, is also not obvious over McNeilly in view of Bergman and in further view of Reed and Thakur for the above same reason.

Accordingly, withdrawal of the 35 U.S.C. § 103(a) rejection for claim 4 is respectfully requested.

CONCLUSION

In view of the foregoing, it is believed that all claims now pending, namely Claims 1-10, patentably define the subject invention over the prior art of record and are in condition for allowance and such action is earnestly solicited at the earliest possible date.

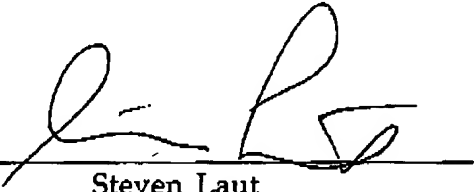
If necessary, the Commissioner is hereby authorized in this, concurrent and future replies, to charge payment or credit any overpayment to Deposit Account No. 02-2666 for any additional fees required under 37 C.F.R. §§ 1.16 or 1.17, particularly extension of time fees.

Respectfully submitted,

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Linda D'Elia April 15, 2003

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Attachment: Figures 1 and 2 for clarification purposes (2 pages)